

INDIANA'S WATER SHORTAGE PLAN

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INDIANA DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER



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I. Introduction

Indiana has experienced droughts of varying severity in the past; however, the drought of 1988 focused attention on the widespread impacts of such a natural disaster and the need to have a plan to minimize the negative effects of the disaster and maximize the positive response to it.

In 1991 the Indiana General Assembly enacted House Bill 1260, codified as Indiana Code 13-2-6.1-10 (since repealed) which required that the Indiana Department of Natural Resources develop a plan to meet the needs of the citizens and environment of Indiana when the shortage of water threatens (1) the health, safety, welfare, or economic well-being of the citizens; or (2) the environment; of any part of Indiana. The statute mandates that the Department consider specific items including:

- 1) Criteria for identifying
 - a) the onset of a water shortage; and
 - b) various stages of severity of a water shortage
- 2) Establishment of relative priorities of water uses in various stages of a water shortage.
- 3) Provisions authorizing increased groundwater withdrawals, the use of a part of minimum stream flows, use of water stored in lakes and reservoirs and water conservation programs.

II. Purpose

The purpose of this plan is to provide the State of Indiana with an effective and systematic plan to assess and manage the State's water resources during a water shortage or potential water shortage to respond, to the maximum extent practicable, to the needs of its water users while protecting its environment. It is intended to serve as a tool for the State of Indiana to guide the use and management of the state's water resource as the availability of that resource diminishes during events such as drought. While portions of the plan may be utilized to address localized water shortages caused by isolated events (i.e. loss of a primary well or wells or a reservoir dropping to critical levels) it is presumed that the document will be most useful in addressing regional water shortages which typically result from drought events.

This document is intended to provide a plan of response as a water shortage develops. It should be noted that efficiency of use and conservation are topics which have received little attention in the past in the state of Indiana. Efficient water supply systems and conservation measures will reduce the demand on the resource and assist in minimizing the impacts of a water shortage on the State's citizens.

Efforts to promote efficiency and encourage conservation of water are therefore, a planning tool which would be preferable to attempting to balance the needs and wants of water users in times of water shortage. Therefore, as a first step to planning for water shortage, the State of Indiana should encourage support and promote both water conservation and efficient use of its water resource. Information concerning water conservation is included in Section V, and a suggested ordinance for the conservation and rationing of water furnished by a public water supply system is included in Appendix III of this report.

III. Water Shortage Task Force

For purposes of administering this plan, it is recommended that a Water Shortage Task Force be created. The Task Force will assume the role of policy coordination during times of water shortage, reviewing and recommending alternative policy response options to the Governor. The task force should include representatives from the most relevant agencies within government and should include other representatives with expertise in the field of water use and/or management. Included in the make-up should be representatives with expertise and/or knowledge of instream uses. It is recommended that the task force be created legislatively with a mandate to meet annually or semi-annually. Required meetings will assist in developing awareness, coordination and cooperation in the event that a water shortage does occur. Since statewide response to a water shortage may extend to sectors not related with the water resource, the task force may best be chaired by the Governor, Lieutenant Governor or their appointee. Membership of the task force should include representatives of the State Emergency Management Agency (SEMA), Department of Natural Resources (DNR), Indiana Department of Environmental Management (IDEM), Office of the Commissioner of Agriculture, Utility Regulatory Commission (URC), Indiana Department of Health (IDOH), and a representative of each major water/interest group identified in the plan. It is recommended that as the water shortage develops and decisions must be made in various affected regions, membership of the task force be expanded to include local input from area water users. Area representatives should either be water interest groups, local elected officials or a combination of the two. Upon declaration of a water shortage emergency, regional input shall be sought by the Task Force to identify priority uses in the affected region prior to determining any mandatory restrictions which might be implemented in a region.

IV. Definition of Water Shortage

The enabling legislation refers to the development of a water shortage plan since the Legislature recognized that water shortages could occur for a variety of reasons including drought, catastrophic occurrences, increased demand, lack of planning, etc. Typically drought is the most recognized cause of a water shortage and can impact users in a large geographical region. Because drought is a natural climatic event and their recurrence is inevitable, much work has been done to develop criteria to identify the onset and severity of drought and to plan response actions to the various stages of drought. Of the many definitions of drought, the legislative intent appears to include a water management drought which characterizes water deficits resulting from water management practices or facilities. Therefore, for purposes of this plan, water shortage refers to a limitation of the water supply resulting from natural phenomenon such as drought and problems of water distribution and use.

V. Water Conservation Measures

As noted previously, efforts to promote efficient water use and encourage conservation of water are a planning tool which would be preferable to attempting to balance the needs and wants of water users in times of water shortage. Effective water conservation involves the entire community and consists of many of the following basic steps.

A. Individuals

1. Find and fix water leaks.
2. Install water-efficient plumbing fixtures.
3. Eliminate wasteful water habits, such as running the dishwasher or clothes washer when only half full or allowing unused water to run.
4. Reduce outdoor water use, e.g. water in the cooler parts of the day, use landscaping that requires

little water.

5. Cut back on non-essential uses, e.g. washing one's car.
6. Reuse water for non-drinking purposes, e.g. for watering plants.

B. Water and Wastewater Utilities

1. Meter all water users.
2. Charge for water and sewer service based on the amount used.
3. Charge more for water and sewer service per unit, as use increases, if approved by the URC.
4. Increase billing frequency to increase awareness of use.
5. Charge more for water during seasons of peak use, if approved by the URC.
6. Examine the water distribution system for leaks at regular intervals, and repair leaks promptly.
7. Reduce excessive water pressure in the distribution system.

C. Local Government

1. Adopt water-efficient plumbing, landscaping, and building codes.
2. Develop a program to replace water-wasting plumbing fixtures in existing buildings.
3. Reduce municipal water use, e.g. plant water efficient vegetation and install high efficiency plumbing products on city property.
4. Educate water users about conservation.

D. State Government

1. Require conservation as part of water supply grants and loans.
2. Adopt a state wide plumbing code for water use efficiency.
3. Promote water conservation in state facilities.
4. Include conservation measures as a condition for issuing state permits or licenses for water or wetlands development.

E. Benefits of Water Conservation

Saving water provides benefits for the environment and for the community. Water Conservation benefits all communities, even if they have a stable and sufficient water supply. Efficient use of water can help prevent pollution, protect aquatic ecosystems, conserve energy resources, and save substantial amounts of money, among other benefits.

1. Using less water reduces the burden on wastewater treatment plants and septic systems, improving the quality of our lakes, rivers, and marine waters.
2. Diverting less water from our rivers and lakes helps maintain a healthy aquatic environment. Building fewer and smaller water supply projects can help preserve wetlands that naturally filter pollutants.
3. Water efficiency means less energy is used to pump, treat and heat water.
4. Conserving water may be quicker and cheaper than developing a new water supply.

VI. Water Shortage Contingency Plan Phases and Restrictions

A. General

Using the recommendations discussed in following Sections, this Section sets forth water shortage response actions to be undertaken by various State and local agencies, public water supply systems, and users under various stages of water shortage conditions. The declaration of water shortage stages, and actions taken in response to such conditions, may be undertaken for the entire State, for one or more of the Water Shortage Contingency Regions of the state (as shown in Figure 1) or for one or more areas or localities as dictated by the criteria described in Section IX(D).

The overall objective of this plan is to identify and establish management responsibilities and actions to be taken at various stages of a water shortage in order to assure: (1) protection of public health, safety, and welfare; (2) preservation of essential water uses; (3) equitable sharing of available supplies; and (4) conservation of water resources. As suggested in Section II previously, the promotion of conservation measures and efficient use of the resource at all levels when no water shortage exists would help minimize the impact on the State's water users when such an event occurs. Such practices may also extend the time between declaration of the various phases discussed below. **The plan is designed to establish a staged phasing of water shortage response actions in order to allow orderly and coordinated preparation for, and implementation of, conservation measures and other necessary actions as conditions worsen, and to provide for appropriate relief and relaxation of use restrictions as conditions improve.**

The response actions, conservation measures and water use restrictions specified in this plan may be modified by the Governor, the State Emergency Management Agency acting in consultation with the Indiana Department of Natural Resources, Department of Environmental Management and other agencies as necessary to respond to changing conditions and to achieve water use reductions determined to be necessary under the circumstances.

B. Definitions

1. "Department" means the Department of Natural Resources.
2. "Task Force" means the Water Shortage Task Force as might be created pursuant to the recommendation in Section III of this report.
3. "Water Shortage Contingency Regions" means the twelve Water Management Basins (shown in Figure 1) developed for conducting Indiana's water resource assessments as required by IC 14-25-7-11(1).
4. "Water Shortage Stages" for the purposes of this plan means the four stages that are designated based on the value of the Palmer Hydrologic Drought Index or exceedance values of regionalized monthly average



Figure 1. Indiana counties and Water Management Basins.

river flows. The stages and their associated criteria are listed below:

<u>% of time flow is</u> <u>Stage</u>	<u>Palmer Index</u>	<u>or</u>	<u>equaled or exceeded</u>
Normal	+1.99 to -1.99		up to 75%
Watch	-2.00 to -2.99		75% to 90%
Warning	-3.00 to -3.99		90% to 95%
Emergency	-4.00 or less		over 95%

C. Phase 1: Water Shortage Watch

1. Objective

The objective of the watch stage is to alert government agencies, public water supply systems, and the public regarding the onset of conditions indicating the potential for future water shortage problems. The focus of this stage is increased monitoring, awareness and preparation for response to water shortage conditions should conditions worsen. The objective of voluntary water conservation measures during this stage is an overall reduction in water use of 5% in the affected areas.

2. Declaration

- a. When, a Water Shortage Watch is indicated for the entire state, a region, area or locality, the Department shall advise the Governor, Lieutenant Governor, and the Director of the State Emergency Management Agency (SEMA) of such conditions.
- b. SEMA will advise the members of the Water Shortage Task Force and other appropriate State agencies of the onset of such conditions.
- c. The Department, in consultation with SEMA, will issue press releases and other notification to the media as it deems appropriate to advise the public of the potential onset of water shortage conditions.
- d. The Department, as it deems appropriate, will consult with the Drinking Water Branch of the Indiana Department of Environmental Management (IDEM), and advise public water supply systems in the affected area by telephone or letter regarding the onset and declaration of watch conditions.

3. Response Actions

- a. The Department will initiate and maintain increased monitoring of climatic, hydrologic, and water supply conditions in the affected area.
- b. The Department, in conjunction with the Drinking Water Branch of IDEM will review and contact, as appropriate, public water supply systems in the affected area to ascertain the status of water supply availability and demand, and will identify systems which may be confronted with an insufficient water supply source or other problems, particularly in the early part of the

water shortage.

- c. The Department will advise the Governor, SEMA and other state agencies regarding the progress of conditions through reports issued on a bi-weekly basis.
- d. SEMA, in consultation with the Department, will convene the Water Shortage Task Force to review responsibilities under this plan and to coordinate any necessary preparations for response actions.
- e. The Department will, as it deems appropriate, issue advisories to the public encouraging voluntary conservation measures of the type specified below under “Water Conservation Program”.

4. Water Conservation Program - Water Shortage Watch

The following voluntary water conservation measures and programs will be encouraged during the watch stage:

a. Domestic and Other Sanitary Uses

The Department and public water supply systems should step-up public education programs concerning the reduction of in-home domestic use by implementing water conserving measures and installing water conserving devices. Additional recommendations may apply for outdoor irrigation use as outlined in Item f.

- (1) Inside and outside aesthetic uses of water (i.e. lawn watering) should be voluntarily reduced.
- (2) Water used for washing and/or flushing streets, driveways, and other impervious areas should be voluntarily reduced.
- (3) Water used for recreation should be voluntarily reduced.
- (4) Water used for outside pressure cleaning should be voluntarily reduced.
- (5) The use of water for automobile and other mobile equipment washing, including boats and trailers, should be voluntarily reduced.
- (6) The use of water for cooling and air conditioning should be voluntarily reduced.

b. Essential Service Use

- (1) Fire hydrant flushing should be undertaken only as necessary for protecting human health, safety, and welfare. Fire departments and other agencies should exercise restraint and review maintenance schedules in light of the water shortage watch conditions.
- (2) Sanitary sewer line flushing and testing should be restricted to those activities necessary for protecting human health, safety, and welfare and proper functioning of the system. Sewage system operators should exercise restraint and review maintenance schedules in light of water shortage watch conditions.

c. Public Water Supply System Use

- (1) Public water supply systems should continue to initiate or consider initiating all reasonable conservation measures including improving and accelerating leak detection surveys and repair programs, installing and calibrating meters, and other water saving measures that may be appropriate.
- (2) Water shortage contingency plans should be developed by those public water supply systems which do not have such plans available for implementation if the water shortage should continue.
- (3) Public water supply systems should enact an ordinance enabling them to conserve and ration water as necessary.

d. Industrial and Commercial Use

- (1) Recycled water should be voluntarily used wherever possible to reduce freshwater use.
- (2) Users should initiate or continue conservation measures, such as employee education and installing water conserving devices, to reduce freshwater use for domestic and sanitary purposes.
- (3) Users of water for commercial and industrial processes should begin planning for voluntary reductions in water use where feasible, and initiate contingency planning for reduction of non-essential uses, plant and equipment cleaning, water-cooled air conditioning, lawn irrigation, and other freshwater uses where applicable. Additionally, programs to reduce leakage and loss of water should be initiated.

e. Institutional Use

Water use should be voluntarily reduced by implementing water conservation techniques. Large institutions (such as schools, colleges, nursing homes, and correctional facilities) should reduce outside uses, implement leak reduction measures, and undertake installation of water saving plumbing devices.

f. Irrigation Use

Current use of irrigation water should be voluntarily reduced by 5% whenever possible and managed to reduce freshwater consumptive use. Drip or trickle irrigation systems should be used where possible.

g. Livestock and Poultry Water

Use should be voluntarily reduced whenever possible.

h. Miscellaneous Uses

- (1) Inside and outside aesthetic uses of water should be voluntarily reduced.
- (2) Water used for washing and/or flushing streets, driveways, and other impervious areas should be voluntarily reduced, unless necessary to protect public health and safety.

- (3) Water used for recreation should be voluntarily reduced.
- (4) Water used for outside pressure cleaning should be voluntarily reduced.
- (5) The use of water for automobile and other non-commercial mobile equipment washing, including boats and trailers, should be voluntarily reduced. Users should be encouraged to use facilities which utilize water recycling equipment, or to use hand-held hoses equipped with automatic shut-off nozzles.
- (6) Water should be served in public and private places of eating only if specifically requested by a customer.
- (7) The use of water for cooling and air conditioning should be voluntarily reduced.

D. Phase II: Water Shortage Warning

1. Objective

The objectives of the warning stage are to prepare for a coordinated response to imminent water shortage conditions and potential water supply problems and to initiate concerted voluntary conservation measures in an effort to avoid or reduce shortages, relieve stressed sources, and if possible forestall the need for mandatory water use restrictions. The objective of water conservation efforts during this stage is a reduction in current water use of 10-15% in the affected area.

2. Declaration

- a. When a Water Shortage Warning is indicated for the entire State, a region, area, or locality, the Department shall advise the Governor, Lieutenant Governor and the Director of SEMA of such conditions. The Department and SEMA jointly will declare the water shortage warning stage.
- b. SEMA will advise the members of the Task Force and other appropriate State agencies of the onset of water shortage warning conditions.
- c. The Department, in consultation with SEMA and the Governor's Office, will issue press releases and other notifications to the media to advise the public of the declaration of a warning and potential for impending water supply problems.
- d. The Department, in conjunction with the Drinking Water Branch of IDEM, will advise public water supply systems in the affected area by telephone or letter regarding the declaration of a Warning.
- e. The Department, through the Division of Water will advise the owners of all registered high capacity water withdrawal facilities in the affected area by telephone or letter regarding the onset and declaration of watch conditions.

3. Response Actions

- a. The Department will maintain increased monitoring of climatic, hydrologic and water supply conditions in the affected area.
- b. The Director of the Department of Natural Resources, in consultation with the Governor and the

Director of SEMA, will appoint an officer of the Department to serve as Water Shortage Coordinator. The Water Shortage Coordinator will be responsible for:

- (1) Coordinating, supervising and directing the preparations and response actions of all Department offices involved in water shortage management activities.
 - (2) Serving as lead liaison and advisor to the Task Force, SEMA and other State agencies regarding water shortage conditions and response actions.
 - (3) Assisting the Director and staff of SEMA in coordinating and directing water shortage response actions by all involved State agencies.
- c. The Department, in conjunction with the Drinking Water Branch of IDEM, will survey public water supply systems in the affected area in order to ascertain the status of water supply availability and demand.
 - d. The Department in conjunction with the Drinking Water Branch of IDEM, will identify public water supply systems which are faced with significant risks for developing water shortage or other problems, and will at least every two weeks continue to survey the status of such systems. The Department, in conjunction with SEMA, will initiate steps to identify potential emergency sources of water and other response actions which may be needed to address problems encountered by such systems and will advise the system operator, and where appropriate, the Utility Regulatory Commission (URC) regarding actions which should be taken to avoid or respond to potential problems.
 - e. The Department will advise the Governor, the Director of SEMA, and other State agencies regarding the progress of conditions through reports issued on at least a weekly basis.
 - f. SEMA, in consultation with the Department, will convene the Water Shortage Task Force to focus plans and preparations for possible imminent implementation of the Indiana Water Shortage Plan and to coordinate ongoing actions in response to current conditions.
 - g. The Department, in conjunction with IDEM, will advise public water supply systems to immediately develop and update water shortage contingency plans for their respective systems, where such plans are not already available for implementation.
 - h. The Department and SEMA, through press releases, the Indiana Department of Commerce, Utility Regulatory Commission or other available means, may advise large industrial, commercial and power plant water users to prepare water shortage contingency actions for reducing their respective water use depending on the seriousness of water shortage conditions encountered in the affected area.
 - i. The Department, in conjunction with SEMA, through the Division of Public Information, will issue advisories to the public and various categories of water users encouraging voluntary conservation measures of the type specified below under "Conservation Program".
 - j. The Department, in conjunction with the Utility Regulatory Commission, will meet with representatives of the Electrical Generating Facilities to discuss contingency planning if the water shortage continues.

4. Water Conservation Program - Water Shortage Warning

The following voluntary water conservation measures and programs will be actively promoted and implemented during the water shortage warning stage:

a. Domestic and Other Sanitary Uses

The Department, municipalities, and public water supply systems should step-up public education programs concerning the reduction of in-home domestic use by implementing water conserving measures and installing water conserving devices. Municipalities and public water supply systems should make concerted efforts to advise the public and consumers of the need for early conservation efforts in light of water shortage warning conditions. Additional restrictions may apply for outdoor irrigation use as outlined in Item f.

- (1) Inside and outside aesthetic uses (i.e. lawn watering) of water should be voluntarily reduced.
- (2) Water used for washing and/or flushing streets, driveways, and other impervious areas should be voluntarily reduced.
- (3) Water used for recreation should be voluntarily reduced.
- (4) Water used for outside pressure cleaning should be voluntarily reduced.
- (5) The use of water for automobile and other mobile equipment washing, including boats and trailers, should be voluntarily reduced.
- (6) The use of water for cooling and air conditioning should be voluntarily reduced.

b. Essential Service Use

- (1) Fire hydrant use should be voluntarily reduced to fire fighting only; other uses of hydrants and hydrant flushing should be eliminated unless necessary to protect human health, safety, and welfare.
- (2) Sanitary sewer line flushing and testing should be restricted on a voluntary basis to those activities necessary to protect human health, safety and welfare. System operators should exercise restraint and review maintenance schedules in light of water shortage warning conditions.

c. Public Water Supply System Use

- (1) Public water supply systems should continue implementing conservation measures, including improving and accelerating leak detection surveys and repair programs, installing and calibrating meters, and other water saving measures that may be appropriate.
- (2) New water line flushing and disinfection should be voluntarily reduced to minimum levels necessary to protect public health and safety.

d. Industrial and Commercial Use

- (1) Recycled water should be voluntarily used wherever possible to reduce freshwater use.
- (2) Users should continue conservation measures to reduce freshwater use for domestic and sanitary purposes.
- (3) Water used for commercial and industrial processes should be voluntarily reduced.
- (4) Users should voluntarily reduce nonessential uses, plant and equipment cleaning, water-cooled air conditioning, lawn irrigation, and other freshwater uses where applicable.

e. Institutional Use

Water use should be voluntarily reduced by implementing water conservation techniques. Accelerated efforts should be taken by residential and other large institutions to install water saving plumbing devices.

f. Irrigation Use

- (1) Current agricultural irrigation utilizing surface water sources should be voluntarily reduced by 10 to 15%, and when possible, conducted during non-peak evaporation and evapotranspiration hours, preferably after 5:00 p.m. and prior to 9:00 a.m. Irrigation should be avoided under conditions of high wind.
- (2) Small scale agricultural irrigation utilizing surface water sources or water from a public water supply system should be voluntarily reduced. Irrigation utilizing water from a public water supply system should be limited to non-peak water usage hours.
- (3) Landscape irrigation of new and existing installations utilizing surface water sources or water from a public water utility should be voluntarily reduced. Irrigation utilizing water from a public water system should be limited to non-peak water usage hours, using a hand-held hose equipped with an automatic shut-off nozzle or a hand-held container for smaller areas.
- (4) Inside and outside irrigation of nurseries utilizing surface water sources or water from a public water system should be voluntarily reduced. Irrigation utilizing water from a public water system should be limited to non-peak water usage hours.
- (5) Irrigation of golf course fairways, roughs, and non-play areas utilizing surface water sources or water from a public water utility should be voluntarily eliminated. Irrigation of greens and tees utilizing water from a public water system should be limited to non-peak water usage hours.
- (6) Irrigation of existing and new recreation areas utilizing surface water sources or water from a public water supply system shall be voluntarily reduced. Irrigation utilizing water from a public water system should be limited to non-peak water usage hours.
- (7) Irrigation of gardens, trees, shrubs and other plants, except by a hand-held hose equipped with an automatic shut-off nozzle or container utilizing water from a public water supply system, should be voluntarily limited to non-peak water usage hours.

(8) Treated wastewater irrigation should be encouraged, upon approval of IDEM.

(9) Freshwater used for irrigation should be applied at a minimum rate when possible.

g. Livestock and Poultry Water

Use shall be voluntarily reduced whenever possible.

h.. Miscellaneous Uses

(1) Inside and outside aesthetic uses of water should be voluntarily eliminated except where water is recycled.

(2) Water used for washing and/or flushing streets, driveways, and other impervious areas should be voluntarily eliminated unless necessary to protect public health and safety.

(3) Water used for recreation should be voluntarily reduced and the use of water for refilling swimming pools and ice skating rinks after draining should be voluntarily eliminated.

(4) The use of water for outside pressure cleaning should be voluntarily reduced.

(5) The use of water for automobile and other non-commercial mobile equipment washing, including boats and trailers, by means other than facilities which utilize water recycling equipment, or by a bucket, pail or hand-held hose equipped with an automatic shut-off nozzle, should be voluntarily eliminated.

(6) Water should be served in public and private places of eating only if specifically requested by a customer.

(7) The practice of regularly draining and refilling air conditioning cooling towers in order to provide cool water for system operations should be voluntarily eliminated.

(8) The use of water for cooling and air conditioning should be voluntarily reduced through means such as increasing minimum air conditioning temperatures and thermostat settings. Public education concerning the need to reduce demand on public water supplies and electric generating facilities must be stressed.

E. Phase III: Water Shortage Emergency

1. Objective

The objectives of management during a water shortage emergency stage are to marshal all available resources to respond to actual emergency conditions, to avoid depletion of water resources, to assure at least minimum water supplies to protect public health and safety, to support essential and high priority water uses and to avoid unnecessary economic dislocations. The objectives of mandatory water use restrictions and other conservation measures during this stage are to reduce consumptive water use in the affected area by at least 15%, and to reduce total use to the extent necessary to preserve public water system supplies, minimum stream flows, to avoid or mitigate local or area shortages, and to assure equitable sharing of limited supplies.

2. Declaration

- a. When a Water Shortage Emergency is indicated for the entire State, a region, area, or locality, the Department will advise the Governor, Lieutenant Governor and the Director of SEMA of such conditions. The Department and SEMA will immediately submit to the Governor a water shortage emergency proclamation for the affected region(s). As warranted by conditions, the Governor, pursuant to his authority under IC 10-4-1, will consider and issue a proclamation declaring a state of water shortage emergency for the affected area(s).
- b. SEMA will immediately advise the members of the Task Force and other appropriate State agencies, and a regular or emergency meeting of the Task Force will be scheduled for the earliest possible date to take such actions as necessary to implement the provisions of the State Water Shortage Plan and coordinate other response actions.
- c. IC 10-4-1, known as the Emergency Management and Disaster Law, confers upon the Governor emergency powers “because of the existing and increasing possibility of the occurrence of disasters or emergencies of unprecedented size and destructiveness resulting from manmade or natural causes, and in order to ensure that preparations of this state will be adequate to deal with such disasters or emergencies, when unpreventable, to prevent or mitigate these disasters where possible, generally to provide for the common defense and to protect the public peace, health, and safety, and to preserve the lives and property of the people of the state.” IC 10-4-1-2 (a). A disaster is defined as an “occurrence or imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural or manmade cause, including but not limited to fire, flood, earthquake, wind, storm, ...(or) drought...” IC 10-4-1-3 (3). If the governor finds that a “disaster has occurred or that the occurrence or the threat of a disaster is imminent,” he shall declare a “disaster emergency..by executive order or proclamation...” IC 10-4-1-7 In performing his duties under this law, “the governor may make, amend, and rescind the necessary orders, rules, and regulations to carry out (its) provisions.” IC 10-4-1-6 (b)(1).
- d. SEMA will advise county and local emergency management coordinators in the affected area of the declaration of a water shortage emergency.
- e. The Department, in consultation with SEMA and the Governor’s Office, will issue press releases and other notifications to the media to advise the public of the declaration of a water shortage emergency and impending or existing water supply problems.
- f. The Department, through the Drinking Water Branch of IDEM, will advise public water supply systems and county and regional water management agencies in the affected area by telephone or letter regarding the declaration of water shortage emergency conditions.
- g. The Department and SEMA, in conjunction with the Task Force, shall attempt to develop recommendations for the Governor regarding possible water use decisions as the severity of the water shortage increases.

3. Response Actions

- a. The Department will maintain increased monitoring of climatic, hydrologic and water supply conditions in the affected area(s).

- b. The Department, through the Drinking Water Branch of IDEM, will continue to survey public water supply systems in the affected area in order to ascertain the status of water supply availability and demand.
- c. The Department, in consultation with IDEM, will identify public water supply systems which confront significant risks for developing water shortages and will, on weekly basis, continue to survey the status of such systems. The Department and SEMA will continue to identify potential emergency sources of water and other response actions which may be needed to address problems encountered by such systems, and will advise the system operator, where appropriate, regarding actions which should be taken to avoid or respond to potential problems. IDEM will be consulted concerning the need to issue emergency permits for the siting and construction of new public water supply wells if necessary.
- d. The Department, through the Drought Coordinator, will advise the Governor, SEMA, and other State agencies regarding the progress of conditions through reports issued on at least a weekly basis.
- e. SEMA, in consultation with the Department, will convene the Water Shortage Task Force as necessary to coordinate the response actions of involved State agencies.
- f. The Department, through the Division of Public Information, and in conjunction with SEMA, will maintain a public media campaign to encourage implementation of all reasonable conservation measures. The campaign will include press releases, briefings, public service announcements, regular advisories to media weather announcers and news staff, and distribution of materials through water utilities and educational institutions.

4. Conservation Program - Water Shortage Emergency

a. Non-Essential Uses

The Task Force will recommend to the Governor to adopt and put into effect emergency regulations restricting non-essential water uses in the affected area. The Task Force may from time-to-time, and as conditions warrant, recommend the amendment of such regulations to respond to actual conditions, and may recommend the adoption of more or less stringent restrictions applicable to all or part of the affected area depending on drought and water shortage conditions and actual conservation achieved.

b. Domestic and Other Sanitary Uses

- (1) The Department and public water supply systems should acquire and distribute information on the availability of packaged kits of water conservation devices which may be installed by domestic consumers. Such distributions will be targeted on a priority basis to public water supply systems and private self-supplied domestic users who confront the highest risks of depleted supplies.
- (2) Non-essential use regulations recommended by the Task Force will be enforced by public water supply utilities and local law enforcement agencies, with technical assistance and advice from the Department.

c. Essential Service Use

- (1) The non-essential use regulations recommended by the Task Force will be implemented by all municipalities, municipal authorities, utilities, fire departments and other responsible agencies in the affected area.
- (2) Water and sewage system operators and public works departments should examine and adjust all maintenance schedules necessary to comply with the non-essential use regulations.

d. Public Water Supply System Use

- (1) Public water supply systems will be responsible for monitoring compliance with the non-essential use regulations recommended by the Task Force applicable to consumers in their service area.
- (2) Public water supply systems should accelerate on a priority basis the implementation of all available conservation measures, including improving and accelerating leak detection surveys and repair programs, installing and calibrating meters, and other water saving measures that may be appropriate.
- (3) The Department may publish and distribute to public water supply systems water conservation information and kits for distribution to consumers, in order to encourage and assist in compliance with water conservation restrictions.
- (4) Public water supply systems will additionally implement the provisions of Local Water Shortage Contingency Plans and Local Water Rationing Plans, as necessary, to respond to water shortages and to balance demands with available supplies.

e. Electrical Generating Facilities

- (1) The Department and the Utility Regulatory Commission will jointly consult with all major electric utilities in the region to ascertain the current status and projection of electric use demand, associated water requirements, and potential for energy and water conservation during the water shortage emergency. Consultations will consider the potential for: (a) shifting a portion of electric energy demand to generation from plants outside the area affected by the emergency (including increased wheeling of energy); (b) increasing energy production from plants with lower consumptive water use rates per unit of energy; and (c) adjustment of plant production and maintenance schedules within the system to reduce water use in the affected area.
- (2) The Department and the Utility Regulatory Commission will jointly, in conjunction with Indiana electric utilities, initiate and maintain a concerted program to encourage conservation and reduction of electric use during the water shortage emergency.

f. Institutional Use

- (1) The operators of all institutions will be responsible for complying with the non-essential use regulations.

- (2) Other water use should be voluntarily reduced by implementing water conservation techniques. Accelerated efforts should be taken by residential and other large institutions to install water-saving plumbing devices.

g. Irrigation Use

- (1) Current agricultural irrigation utilizing surface water sources should be voluntarily reduced by 10 to 15%, and when possible, conducted during non-peak evaporation and evapotranspiration hours, preferably after 5:00 p.m. and prior to 9:00 a.m. Irrigation should be avoided under conditions of high wind.
- (2) Small scale agricultural irrigation utilizing surface water sources or water from a public water supply system should be voluntarily reduced. Irrigation utilizing water from a public water supply system should be limited to non-peak water usage hours.
- (3) Landscape irrigation of new and existing installations utilizing surface water sources or water from a public water utility should be voluntarily reduced. Irrigation utilizing water from a public water system should be limited to non-peak water usage hours, using a hand-held hose equipped with an automatic shut-off nozzle or a hand-held container for smaller areas.
- (4) Inside and outside irrigation of nurseries utilizing surface water sources or water from a public water system should be voluntarily reduced. Irrigation utilizing water from a public water system should be limited to non-peak water usage hours.
- (5) Irrigation of golf course fairways, roughs, and non-play areas utilizing surface water sources or water from a public water utility should be voluntarily eliminated. Irrigation of greens and tees utilizing water from a public water system should be limited to non-peak water usage hours.
- (6) Irrigation of existing and new recreation areas utilizing surface water sources or water from a public water supply system shall be voluntarily reduced. Irrigation utilizing water from a public water system should be limited to non-peak water usage hours.
- (7) Irrigation of gardens, trees, shrubs and other plants, except by a hand-held hose equipped with an automatic shut-off nozzle or container utilizing water from a public water supply system should be voluntarily limited to non-peak water usage hours.
- (8) Treated wastewater irrigation should be encouraged, upon approval of IDEM.
- (9) Freshwater used for irrigation should be applied at a minimum rate when possible.

h. Livestock and Poultry Water

Use shall be voluntarily reduced to absolute minimum levels necessary to maintain normal health, growth, production and reproduction of livestock and poultry.

i. Miscellaneous Uses

All aesthetic, recreation, outdoor irrigation, cleaning and other miscellaneous uses of water should be

reduced or eliminated as dictated by the Task Force.

VII. Use of Ground Water and Water in Lakes, Reservoirs and Streams

The Department of Natural Resources was asked by the Legislature to consider provisions authorizing increased ground-water withdrawals, the use of a part of minimum stream flows and the use of water stored in lakes and reservoirs when a water shortage threatens the environment or the health, safety, welfare or economic well-being of the citizens. The following are recommendations concerning the availability of each of these water supplies that could be made available during a water shortage.

A. Ground Water

Significant amounts of ground water are available in various parts of the state which can be utilized to meet the short term needs that might be created by the water demands accompanying water shortage conditions. While long term production from new wells would need to be evaluated, the installation of wells to meet the temporary needs of water users during the duration of a drought would be possible in many cases without long term impacts to the resource. However, in the case of public water supply wells, the permitting process of the Indiana Department of Environmental Management may have to be expedited to allow for quick installation of wells. While the necessary data to conduct a detailed analysis of the long term impacts of these well constructions could not be assembled in a timely fashion, information available through the Department's Division of Water Ground Water Section would be sufficient to provide an evaluation of the short term impacts of emergency ground-water development.

B. Minimum Stream Flows

The Water Shortage Task Force is not comfortable establishing a new minimum stream flow standard that could be considered for other regulatory purposes. Recognizing that it is desirable to protect the 7Q10 flow where possible to ensure that water quality is maintained, it would be desirable to initiate reduction to water withdrawals at some point prior to the 7Q10. Therefore, the following recommendations are made:

1. Upon declaration of a Warning Phase as described in Section VI, the Department shall advise, by telephone or letter, all owners of water withdrawal facilities in the affected areas, and registered as required by Indiana Code 14-25-7-15, of the declaration of the Warning Phase and encourage these users to voluntarily reduce their water usage by a higher percentage than the 10 to 15% reduction targeted by the conservation measures suggested for the Warning Phase.
2. Upon declaration of a Warning Phase, the Indiana Department of Natural Resources shall assess the instream flow demands on those streams within the affected area. As a part of this review the Department may consider data or studies which might be available from other sources including the users on the affected streams, consultants and other governmental agencies. The Department shall advise the Task Force of the instream flow needs identified on selected streams, the flow needed to maintain each need and an assessment of the long and short term impacts of allowing withdrawal of portions of those flows needed to meet the identified instream demands. A summary of these findings will be provided to the owners of all registered water withdrawal facilities.

C. Lakes

The State's natural lakes should only be looked to as a water supply source in time of water shortage if there is imminent danger to the public health safety and welfare.

D. Reservoirs With State Owned Water Supply Storage

Since the state has available water supply storage in these reservoirs, statutory changes should be made to allow the Department to enter into short term contracts within a short time frame to allow use of the uncommitted water supply storage in these reservoirs. Priority use should be dictated by the specific uses authorized by the contracts between the State of Indiana and the United States of America on each reservoir.

E. Flood Control Reservoirs

Discussion should be initiated with the U.S. Army Corps of Engineers to determine if waters from the reservoirs may be made available for use during a water shortage and suitable agreements developed to establish a mechanism to authorize use of such waters that may be available.

VIII. Water Use Priorities

A. General

During times of water shortage, the need to reduce demand on the resource can and will exist. Decisions regarding the uses which are deemed to have the highest priority will not be easy and may not be clear cut. Indiana Code 14-25-1-3 provides that: “the owner of land contiguous to or encompassing a public water course shall at all times have the right to the use of water therefrom in the quantity necessary to satisfy his needs for domestic purposes, which shall include, but not be limited to, water for household drinking purposes and drinking water for livestock, poultry and domestic animals. The use of water for domestic purposes shall have priority and be superior to any and all water uses.”

The priorities of other uses must therefore be determined on some reasonable standard. Guidance in these decisions may be found in policy statements made in both Indiana Code 14-25-1-1 and 14-25-3-3 which state: “(a) that the general welfare of the people of the State of Indiana requires that the surface water resources of the state be put to beneficial uses to the fullest extent and that the use of water for non beneficial uses be prevented...”; and (b) “It is a public policy of this state in the interest of the economy, health, welfare of the state and the citizens of Indiana, to conserve and protect the ground water resources of the state...”

In establishing priorities, emphasis must be given to high capacity water uses since these users have the largest impact on the resource. Categories have been established for these users and include the following 7 uses:

- (1) Domestic Supply
- (2) Public Supply
- (3) Energy Production
- (4) Irrigation
- (5) Industrial
- (6) Rural
- (7) Miscellaneous

It should be noted that these are all withdrawal uses and do not include instream uses. Certain instream uses will have little or no priority in the event of serious drought but may bring the loudest public outcry. Included in these uses would be swimming, recreational boating, and aesthetic appearances. Other instream uses such as minimum stream flows to prevent water quality degradation or wetlands preservation must be recognized and addressed as a priority use.

In managing a reduced resource in times of water shortage it is important to recognize that portions of the water utilized in each of the above segments is necessary while others are not. For example:

1. Drinking water for customers, health care facilities, and fire fighting is high priority while water for lawn watering and car washing is not.
2. Cooling water for electrical generating stations is necessary for the production of electricity; however, in times of water shortage the continuous running of air conditioners raises demand but may not be necessary for all users.
3. Irrigation uses involve both crop production and golf course watering. Crop production would seem to be more important than keeping green grass on a golf course.

A simple ranking of the eight above mentioned uses (instream uses being number 8) would be a simplistic approach to managing the water resource. In addition to the problems within each of these categories, it should be noted that some uses will not exist within each of the 12 regions. In addition, within each withdrawal use, some users will be more efficient or more effective in conserving the resources.

B. Conclusion

The following recommendations are made relative to establishing water use priorities in times of water shortage:

1. Consideration should be given to both instream and withdrawal uses, and whether the source is from surface water or ground water.
2. All management decisions should attempt to preserve minimum stream flows in accordance with the discussion in the section which follows.
3. Domestic water supply shall have the highest priority.
4. All uses essential for protecting the public health, safety, and welfare shall have priority.
5. Priorities should be assessed in each region based upon existing uses. Regional advisory boards consisting of at least a representative of each water use may be created once a Water Shortage Warning is in effect.
6. Non-Essential uses should be given lowest priority.
7. Water use restrictions should be evaluated in light of the use. For example, a 10% mandatory reduction on all uses may result in a loss of a higher percentage of generating capacity at a power plant.
8. Users promoting or demonstrating efficiency and/or conservation in use should be given higher priority than those not demonstrating such capability.
9. Existing users shall be given priority over new users unless such use is necessary for maintaining the public health, safety and welfare.
10. Distinctions should be made between consumptive and non-consumptive uses.

11. In accordance with IC 14-25-4-12, the ground-water resource of an area shall be protected against high capacity withdrawals that exceed the recharge capability of the resource.

IX. Overview of Water Shortage Plan Development

A. General

During the early summer of 1988, cumulative rainfall amounts were significantly below normal levels and Indiana, as well as many other Midwestern States, was clearly in the midst of a severe drought. Climatological data indicated that by the end of June the plight of many drought stricken areas would reach the crisis level. As a result on June 22, 1988, Governor Robert D. Orr created the Indiana Drought Advisory Committee to coordinate at the state level all of the issues related to drought. Membership of the Committee included representatives of a large number of agencies and the findings of the Committee were included in the Indiana Drought Advisory Committee Report, September, 1988. Presented in the report is an overview of drought associated problems throughout the state coupled with identified solutions to those problems.

The introduction to the Committee's report concludes by stating: "This report is intended to serve as a preparatory document in the event that Indiana experiences a rainfall shortage in the future similar in severity to the 1988 drought and it is hoped that the information contained herein will help expedite the state's reaction in the future should a drought occur". While the 1988 Drought Committee addressed a broad spectrum of drought related issues, their report contains information concerning significant problems related to reduction of the water resource as a result of the drought. The experiences of the 1988 Drought suggested to the Indiana Department of Natural Resources that a drought of similar or greater severity would lead to significant conflicts between the users of the state's water resource, and no clear cut guidelines exist at the state level to address and/or respond to these conflicts. In addition, there are currently no guidelines available for existing and potential users of the state's water resources to identify what actions would be taken by the State in times of water shortage. As a result, the Department suggested to the Water Resources Study Committee that there was a need for the State of Indiana to develop a plan which would outline the actions which would or could be taken at the State level in times of water shortage.

The plan was developed with the advice and assistance of the Advisory Council for the Bureau of Water and Resources Regulation augmented by 8 additional members, appointed by Governor Evan Bayh, with expertise or responsibility in matters relevant to water shortage.

As required by statute, five public meetings were held to receive public comment on the draft plan and on problems the plan is to address. The dates and locations of these meetings are as follows:

<u>Location</u>	<u>Date</u>	<u>Time</u>
(1) Vincennes	March 14, 1994	7:00 p.m., E.S.T.
(2) Columbus	March 15, 1994	6:00 p.m., E.S.T.
(3) Indianapolis	March 15, 1994	9:00 a.m., E.S.T.
(4) Elkhart	March 16, 1994	9:00 a.m., E.S.T.
(5) Valparaiso	March 16, 1994	7:00 p.m., C.S.T.

The comments received were reviewed and considered by the Advisory Council and appropriate amendments to the plan were made based on these comments. This final report which is being submitted to the Water Resources Study Committee includes the following:

1. A plan to address state water management actions.

2. Documents which might provide assistance to communities, individuals and agriculture in responding to the effects of a water shortage.
3. Recommendations for possible legislation to implement the plan.

In preparing this plan, the members looked to the 1980 Governors Water Resource Commission publication entitled "The Indiana Resource: Recommendations for the Future" which describes two categories of water uses: Withdrawal and instream. Instream uses are defined as those which are made of surface water in place. They include fishing, boating, swimming, urban and agricultural drainage, the disposal of liquid wastes, navigation, hydroelectric power generation, the passage of flood flows, and general aesthetic enjoyment. In addition, surface water is the natural habitat of a variety of birds and animals. Of these varied uses aquatic organisms, fishing, swimming and aesthetic enjoyment are directly and immediately related to water quality. Commercial navigation, recreational boating and hydroelectric power are dependent upon adequate and dependable flows, depths and surface areas. The waste assimilative capacity of streams is a direct function of the rate of stream flow. Finally, it is important to note that many instream use demands reach their peak during natural low flow periods for streams.

Withdrawal uses are defined as those uses which involve the physical removal of water from its ground or surface source. Withdrawal uses include both consumptive and non-consumptive uses. Consumptive uses are those that, because of evaporation, transfer out of the basin of origin, incorporation into manufactured products or other processes, preclude the return of some or all of the withdrawn water to its source. Non-consumptive uses as the term implies are those in which the withdrawn water is returned to the supply system essentially undiminished in volume. In Indiana, withdrawal uses have been divided into the following categories: Public Supply, Irrigation, Energy Production, Industrial, Rural and Miscellaneous. Similar to instream uses, many withdrawal and consumptive uses peak during natural low flow.

In attempting to manage a reduced resource during periods of water shortage, it is important that both categories be considered. Protection of instream flows to prevent water quality degradation and damage to aquatic habitat such as wetlands and fisheries should not be sacrificed in the short term without consideration of the long term impacts of such acts on the environment. However it should be recognized that in establishing priorities of water use in water shortage conditions, certain withdrawal and instream uses will receive little or no consideration.

In order to balance and manage these uses in times of water shortage it is important to note the state policy set forth in IC 13-12-4-3.

"(a) the general assembly...declares that it is the continuing policy of the state of Indiana in cooperation with the federal and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Indiana citizens.

(b) In order to carry out the policy set forth in this chapter, it is the continuing responsibility of the state of Indiana to use all practicable means, consistent with other essential considerations of state policy, to improve and coordinate state plans, functions, programs and resources to the end that the state may:

- (1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- (2) Assure for all citizens of Indiana safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
- (3) Attain the widest range of beneficial uses of the environment without degradation, risk to health

or safety, or other undesirable and unintended consequences;

- (4) Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
- (5) Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
- (6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

The impacts of drought or water shortage may extend beyond the water resource and ultimately may involve differing levels of government. It is not the intent of this plan, or the legislative directive to develop a plan which would address government's response to all the consequences of a drought or a water shortage. This plan deals only with issues related to a diminishing water resource and is intended to improve the State of Indiana's ability to recognize the onset of a water shortage and to respond so as to minimize the impacts of such an event on the State's water users and its environment.

B. Determination of Water Shortage Definition

Water shortages are most commonly thought of in terms of drought. Drought is difficult to define and many different definitions have emerged. Hydrologists think of a drought in terms of the effects of precipitation deficits on ground-water levels, streamflow, and reservoirs. To a meteorologist, a prolonged period of moisture deficit, be it 1 month or 1 year, denotes a drought of varying severity. A water manager defines a drought relative to water availability and quality. Reduction in available supply for whatever reason or degradation of water quality can result in a water shortage. Either of the above could occur independent of climatic factors. If a water shortage occurs during a critical phase of the growing cycle, even a very short period with a moisture deficit can become a costly drought to a farmer. Residential consumers often are unaware of water shortage conditions until they are affected directly by water restrictions and shortages.

Water shortages caused by reasons other than drought would probably impact smaller areas and may not be recognized until a crisis situation exists. It is hoped that this document can be useful in managing the water resource no matter what the cause. However for purposes of discussing the onset of a water shortage it is useful to look at the definition of drought and the criteria for identifying the onset of drought.

A drought can be defined in general terms as "... a condition of moisture deficit, sufficient to have an adverse effect on vegetation, animals, and man over a sizable area". Any one definition is not adequate for all situations because droughts are measured using different criteria, including precipitation and temperature statistics, ground-water levels and low-flow characteristics, soil moisture values, and economic factors (for example, crop yields and livestock production).

Six types of drought are recognized by the World Meteorological Organization. They are:

- (1) Meteorologic drought — defined only in terms of precipitation deficits in absolute amounts for specific durations.
- (2) Climatologic drought — defined in terms of precipitation deficits, not in specific amounts but as a ratio of actual precipitation to mean or normal values.
- (3) Atmospheric drought — definitions involve not only precipitation but possible temperature, humidity, or wind speed.
- (4) Agricultural drought — definitions involve principally soil-moisture content and plant physiology,

perhaps for a specific crop.

- (5) Hydrologic drought — defined in terms of reduced streamflow, reductions in lake or reservoir storage, and declining ground-water levels.
- (6) Water-management drought — characterizes water deficits resulting from water-management practices or facilities.

The drought types can occur separately, overlap, or be combined in different ways. For example, a small amount of precipitation (a meteorologic drought), when extended over a long period, becomes a climatologic drought. As ground-water, streamflow, and reservoir levels decline, a hydrologic drought occurs, resulting in problems of water distribution and use, which then becomes a water-management drought.

1. Conclusion

Definitions numbered 5 and 6 appear to most closely describe “water shortage” as envisioned by the legislature.

C. Determination of Water Shortage Contingency Regions

Numerous methods exist to divide the State into regions including surface drainage divides, political jurisdictions, etc. A major factor impacting the criteria for dividing the state into regions would be the availability of data which could be used to monitor drought or water shortage conditions in a given region. Past experience has indicated that stream flow data and rainfall data are perhaps the most readily available on a statewide basis.

One useful method would be the nine climatic regions designated in Indiana by the National Weather Service. Monthly precipitation data are available for each of these divisions since the late 1890’s and the extent of these divisions is shown in Figure 1. The climatic divisions are useful since the lack of precipitation is a principal factor involved in periods of drought. Precipitation deficits typically exist prior to the observation of the more significant and obvious effects on plants, animals, and people. These divisions appear to be an attempt to divide the State into nine equal parts (although Division 5 is significantly larger) rather than based on any geologic or scientific rationale. Experience in 1988 and in 1992 demonstrated rainfall variations in the nine regions maybe a useful method for dividing the State for planning purposes.

While rainfall deficits are extremely useful information, the climatic divisions cross drainage divides and do not include the entire length of a stream on which water use may need to be monitored or reduced. In attempting to manage a reduced water resource, it is preferable to develop management areas based on a watershed basis. In this way, if the water use in a selected drainage basin must be reduced, the burden can be distributed to all users in the watershed rather than a portion of the basin. Management of the resource in the affected regions would be dictated by identifying the withdrawal and instream uses in a given drainage basin and developing priorities based on those identified needs. For purposes of developing its Water Resources Assessment Studies, the Division of Water (IDNR) has delineated 12 major drainage basins in the State as shown on Figure 2. The State of Indiana in cooperation with the United States Geological Survey maintains a network of both surface and ground-water gaging stations throughout the State. Data on rainfall, stream flows and ground water levels could be easily obtained in each drainage basin.

1. Conclusion

It is suggested that the monitoring and management measures recommended in this plan be based on the State’s 12 major drainage basins.

D. Determination of Criteria to Identify Onset of Water Shortage

The legislature also asked the Department to consider including criteria for identifying the onset and various stages of severity of a water shortage. Factors on which to base such criteria include: stream flow, ground-water levels, available reservoir storage, precipitation and season. It should be noted that since drought is a natural climatic event, it is easier to identify its onset than water shortages which may result from water management practices or system failures. The latter will most likely be unanticipated and in many cases at a more advanced stage of severity once it is brought to the attention of appropriate authorities.

A discussion of the most readily available and useful data for identifying the onset and stage of a water shortage follows:

1. Precipitation

The lack of precipitation is the principle factor involved in periods of drought. Precipitation records are the most useful and readily available data for monitoring water shortage conditions on a meteorological basis. Monthly precipitation data are available since the late 1890's for each of the nine National Weather Service climatic divisions in Indiana (Figure 2).

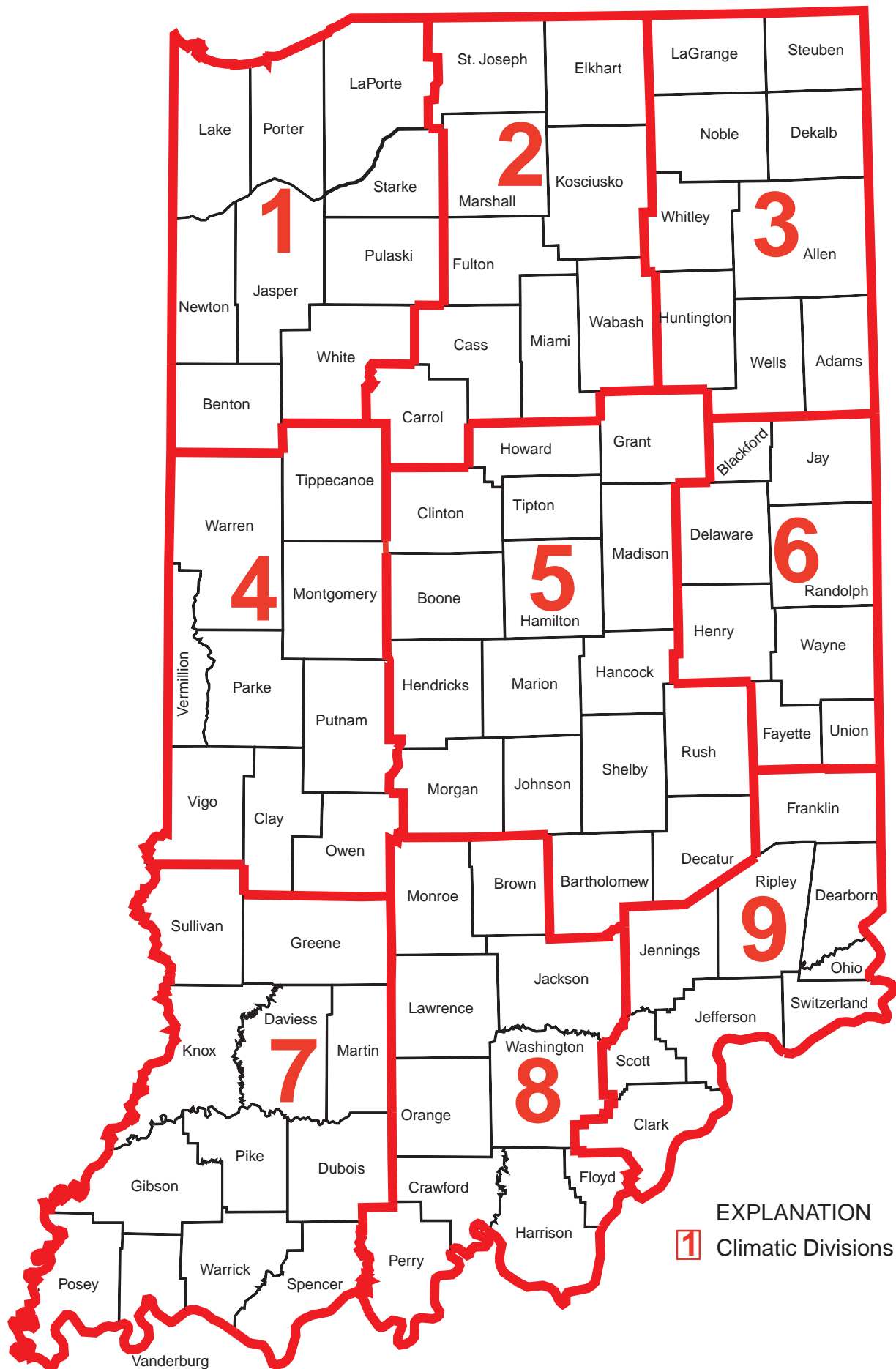
The two most significant characteristics of precipitation in relation to drought are the magnitude and duration of deficits. Precipitation deficits are the difference between actual precipitation and the long term average precipitation for the specified period. Determination of cumulative departures from the mean is one method of evaluating long term climatic or hydrologic trends. By use of this method, departures of the monthly mean from the long term mean monthly value are accumulated algebraically through the period of record and plotted against time. The plot of cumulative precipitation departures from mean precipitation can be constructed for the entire record, for the driest period, or for several dry periods in order to compare drought severity.

As a part of a report prepared by the United States Geological Survey, in cooperation with the Indiana Department of Natural Resources, cumulative departures from mean monthly precipitation were calculated for each of the nine climatic divisions in Indiana for the years 1921 to 1989. A copy of the graph for Division 8 is shown in Figure 3. The slopes on the graphs from year to year are more descriptive than the vertical position. A rising or positive slope on the graph shows above average precipitation, whereas a declining or negative slope indicates below average precipitation. Periods with no discernible trends indicate generally average precipitation with both wet and dry years. For the period of 1987-89 the graphs of Indiana's nine climatic regions indicate a moderate drought of relatively short duration when compared to previous records of negative departures. For example in Figure 3, longer, more severe periods of negative departures (declining slopes) occurred during 1941-49 and 1964-75.

Comparison of precipitation deficits to the period of record and the graphs discussed above, in conjunction with other data sources, will provide a useful tool in identifying the possible onset and severity of future drought events.

2. Palmer Drought Severity Index (PDSI)

A number of drought indices have been developed utilizing meteorological data in order to determine stages of drought severity. One such index is the Palmer Drought Severity Index which provides a means of describing periods of unusually wet or dry weather. This index, which has been widely adopted, is an excellent measure of an agricultural drought. It is based on long term records of temperature and precipitation. Normal weather has an index value of zero in all seasons in any climatic region. Droughts have negative index values, while wet periods have positive values. Consecutive negative values can provide warning of a developing



EXPLANATION
1 Climatic Divisions

Figure 2. National Weather Service climatic divisions of Indiana

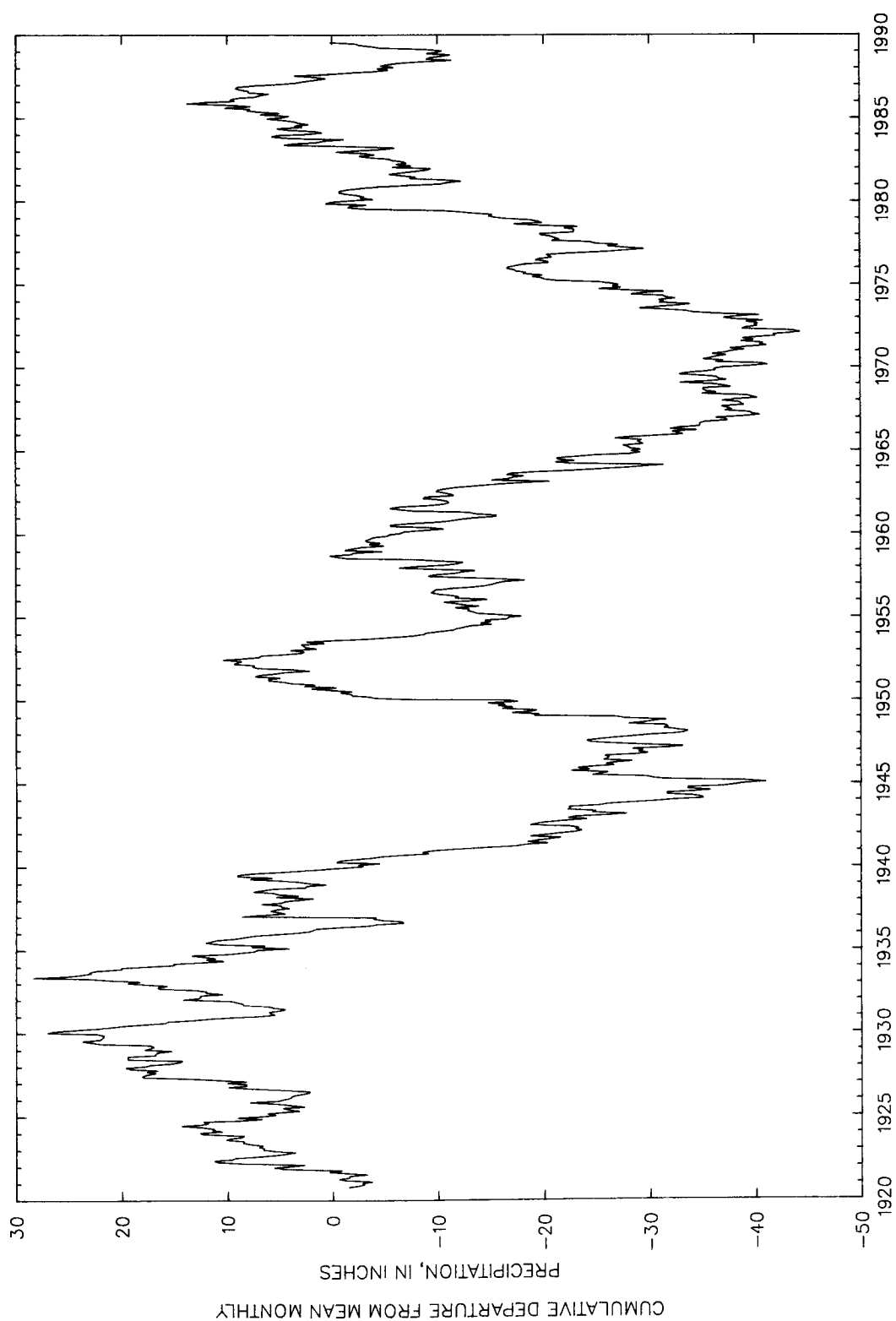


Figure 3. ---Cumulative departure from mean monthly precipitation for climatic division 8, water years 1921-89 (data from National Oceanic and Atmospheric Administration, Climatic Data Center).

drought. During drought, the magnitude of negative values indicates drought severity.

This monthly meteorological drought index assesses the relative severity of dry periods. The method used to derive the index for each period incorporates antecedent precipitation, precipitation during the time being evaluated, and the duration and magnitude of the moisture deficiency. Values of the PDSI generally range from +7.0 to -7.0, with rare drought conditions approaching -8.0. An index of +2.0 or greater indicates wet conditions; +2.0 to +0.5, moist conditions; +0.5 to -0.5, near normal; -0.5 to -1.0, incipient drought; -1.0 to -2.0, mild drought; -2.0 to -3.0, moderate drought; -3.0 to -4.0, severe drought; and -4.0 and less, extreme drought.

Indiana is divided into 9 climatologic divisions. Palmer Index values are normally prepared for each division on a monthly basis by the National Oceanic and Atmospheric Administration, and available through the National Climatic Data Center in Asheville, North Carolina. Although the index values are less reliable during the December to March period due to frozen ground conditions, they serve as a general guide for assessment of drought conditions. Suggested drought stage indices for Indiana are as follows:

<u>Stage</u>	<u>Palmer Index</u>
Normal	+1.99 to -1.99
Drought Watch	-2.00 to -2.99
Drought Warning	-3.00 to -3.99
Drought Emergency	-4.00 or less

3. Ground-water Levels

Of note when assessing the impact of a water shortage on ground-water levels is the fact that ground-water levels typically respond to precipitation at a slower rate than surface water sources. In drought events ground-water levels will be lowered through above normal demands on aquifer systems as a result of diminished recharge and increased withdrawals by users.

The United States Geological Survey (USGS) in cooperation with the Indiana Department of Natural Resources (IDNR) maintains a ground-water monitoring well network which includes approximately ninety (90) wells. These wells are located to provide a regional assessment of the ground-water resource or to monitor ground-water levels in areas where potential conflicts and/or competing uses may occur. While the period of record for most of these wells is relatively short (15 to 25 years), comparison of current water levels with the period of record does provide some basis for assessing the potential severity of droughts. It should be noted that problems may occur with wells utilizing smaller aquifer systems or as a result of increased withdrawals which may not be recognized as a problem based on the observation well network.

Ground-water levels throughout the State were moderately affected by the 1988 drought. Even before 1988, water levels had begun their decline. During October, November, and December of 1987, many USGS/IDNR monitoring wells recorded below-average water levels. Below-average precipitation throughout the State aggravated the declining levels for most of the first 9 months of 1988. Statewide, above-average precipitation was recorded in only February and July. In July 1988, a ground-water emergency was declared by IDNR for parts of Jasper and Newton Counties in northwestern Indiana where large scale irrigation is practiced. During the emergency, high-capacity wells (wells that withdraw water at a rate of 70 gal/min or more) were prohibited from pumping on weekends. These restrictions were mandated for 90 days.

4. Stream Flow

Twenty-seven selected stream gaging stations were monitored on a weekly basis during the summer of 1988.

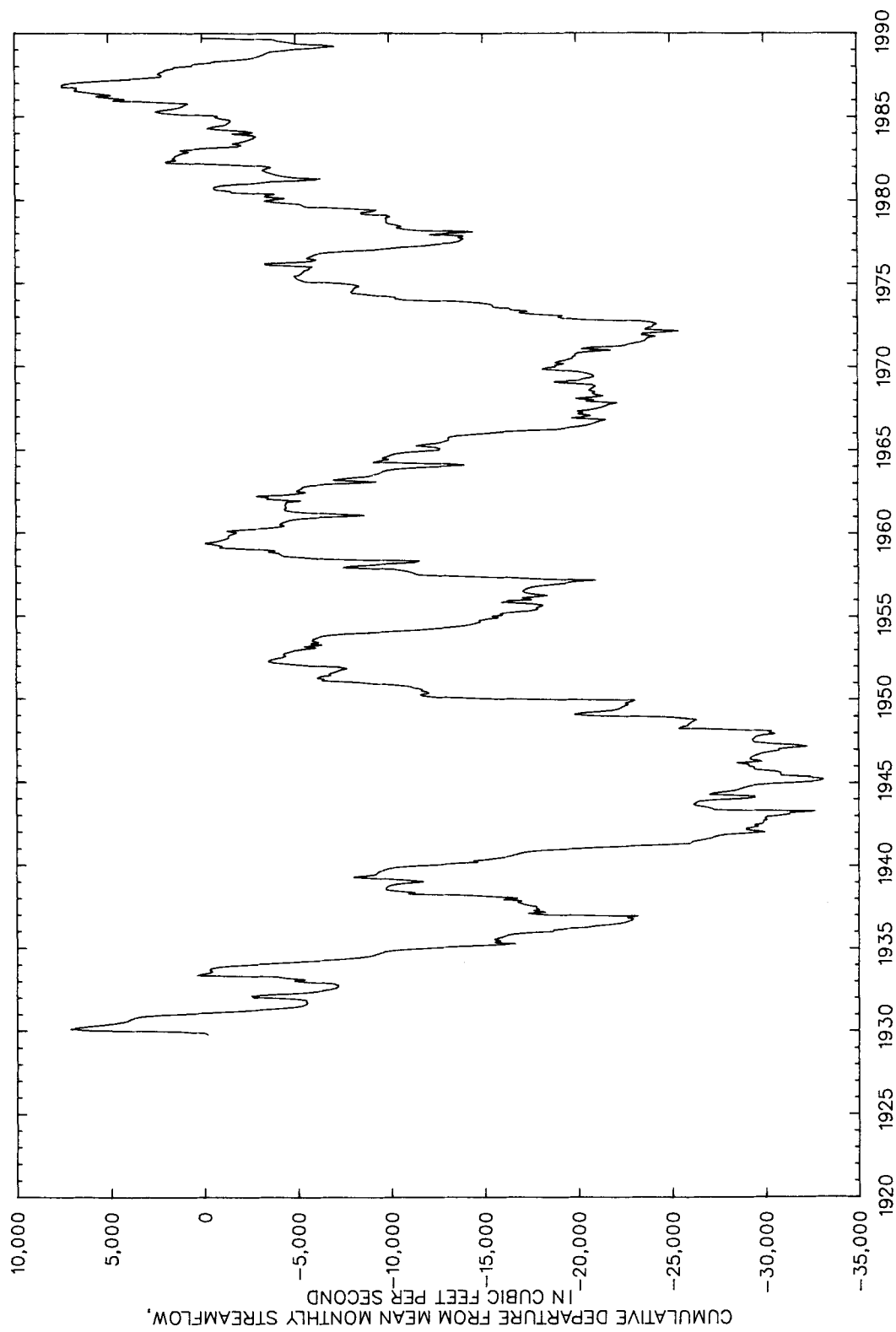


Figure 4. — Cumulative departure from mean monthly streamflow for
White River near Nora (03351000), water years 1930–89.

Weekly stream flows were compared to monthly mean stream flows for the summer months and to the 7Q10 discharge. The 7Q10 discharge is the stream discharge that would occur for seven consecutive days once every 10 years. This value is utilized by the Indiana Department of Environmental Management for purposes of determining permit requirements for discharges to the state's rivers and streams. Stream flow data for gaging stations may be analyzed statistically in a number of different ways. In a report concerning the 1988 drought the United States Geological Survey utilized data from twenty-four gaging stations to graph cumulative departures of monthly mean streamflow for each station's period of record. Cumulative departures of monthly mean stream flow for each of the stations can be calculated by computing the difference between each monthly mean value and that month's long term mean monthly value. The cumulative departures can be plotted to provide a graphical representation of the relative severity of a drought as compared to the entire period of record. Cumulative departure from the mean is one method of evaluating relative severity and long term trends. The slope and length of the lines and the change in their positions from year to year are more important than the vertical location of the lines on the graphs. A positive slope indicates that stream flow during that period was generally above average, whereas a negative slope indicates a period when stream flow was below average. A sample plot for a gage on the White River at Nora is shown in Figure 4.

While the above mentioned method may be valuable for evaluating the relative severity of droughts, it is inadequate to establish a trigger level for drought response. Monthly flow duration curves appear to be the most useful at this time. They show graphically the percent of time given flows are equaled or exceeded on a monthly basis during the period of record. By using monthly flow duration curves, seasonal variability is considered. Various ranges can be established equivalent to water shortage stages. Flows that are equaled or exceeded up to 75% of the time are considered to be in the normal condition. Flows that are equaled or exceeded more often (lower flows) are used for establishing drought conditions.

As noted earlier, the U.S. Geological Survey, in cooperation with the Department of Natural Resources, maintains a network of approximately 175 gaging stations in Indiana. Twenty-seven of these stations were selected to monitor drought conditions in 1988 and will be utilized for purposes of this plan. A list of those gaging stations is shown below:

- Whitewater River near Alpine
- Little River near Huntington
- Mississinewa River at Marion
- Wabash River at Peru
- Eel River at North Manchester
- Tippecanoe River near Ora
- Wildcat Creek near Lafayette
- Wabash River at Lafayette
- Sugar Creek at Crawfordsville
- Wabash River at Terre Haute
- Wabash River at Riverton
- White River near Nora
- Fall Creek near Fortville
- White River near Centerton
- Big Blue River at Shelbyville
- Sugar Creek near Edinburgh
- Flatrock River at St. Paul
- East Fork White River at Seymour
- Muscatatuck River near Deputy
- White River near Petersburg
- Wabash River at Mount Carmel, IL
- Elkhart River at Goshen
- East Fork White River at Shoals
- St. Marys River at Decatur
- Yellow River at Knox
- Kankakee River at Dunns Bridge
- Kankakee River at Shelby

Monthly flow duration curves will be developed for these stations. Streamflows at each of the stations will be monitored on a regular basis to determine the flow conditions. Drought stages have been set as follows:

<u>Stage</u>	<u>% of Time Flow is Equaled or or Exceeded</u>
Normal	Up to 75%
Drought Watch	75% to 90%
Drought Warning	90% to 95%
Drought Emergency	Over 95%

Note: The 7Q10 is generally equal to or less than the Q99.

5. Reservoir Levels

Indiana's reservoirs are an important part of the State's water resources. Deficit precipitation, high temperatures, and low streamflow had adverse effects on these reservoirs during 1988 and 1989. Water supplies for many towns and cities were threatened as water levels declined. Many municipalities dependent on reservoirs for public water supply called for voluntary reductions in water use. The quality of water decreased at some reservoirs as low levels coupled with high temperatures resulted in increased aquatic growth and reduced dissolved oxygen levels. Recreation activities at most of the State's reservoirs were affected. Many beaches and marinas were left dry as water levels fell. Reduced areas of open water resulted in increased congestion for boaters and skiers. With fewer people using recreational facilities, owners and operators suffered variable amounts of economic losses. At the present time the data base on reservoir level fluctuations relative to precipitation deficits is considered to be inadequate to be used as a predictive tool in identifying the onset of a water shortage event.

6. Conclusion

In 1990 the Department entered into a contract with the School of Civil Engineering, Purdue University to evaluate appropriate drought indicators for the State of Indiana. Several time series were studied by Purdue to examine the appropriateness of different drought indicators; these included precipitation deficits, high summer temperatures, low river flows, low ground-water levels, low reservoir volumes and Palmer Hydrologic Drought Index (PHDI). For the purposes of Purdue's study the state was divided into thirds (north, central and southern) each region including 3 of the 9 Climatic Regions discussed above and shown in Figure 1. The results of that study indicated that the monthly average river flow series appears to be the best indicator for early detection of drought. The monthly Palmer Hydrologic Index Series appears to be the best indicator for detecting the onset of droughts of long duration. It was suggested that the 75%, 90% and 95% exceedance levels of regionalized monthly average river flows and monthly PHDI be used as the threshold values for declaring a Drought Watch, Drought Warning and Drought Emergency, respectively in each region.

Using these threshold values for declaration of a Water Shortage Watch (75%) and a Water Shortage Warning (90%), the State could anticipate that a Water Shortage Watch may be declared every four years and a Water Shortage Warning every 10 years. Recognizing this fact the following criteria are proposed to identify the onset and severity of a water shortage.

	<u>Palmer Index</u>	<u>or</u>	<u>% of time flow is equaled or exceeded</u>
Normal	+1.99 to -1.99		up to > 75%
Drought Watch	- 2.0 to -2.99		75% to 90%
Drought Warning	- 3.0 to -3.99		90% to 95%
Drought Emergency	- 4.0 or less		over 95% Monthly

Flow duration curves will be developed using data from representative gaging stations in the existing network and located in the 12 designated Drought Contingency Regions.

X. Identification of Additional Water Supplies Available During a Water Shortage

A. Increased Ground-Water Withdrawals

1. Introduction

Ground water represents an important source of water supply in Indiana; however, only about five percent of the state's total water use during 1990 was reported to be from ground-water supplies. During periods of water shortage due to drought conditions, further development of the existing ground-water resource could represent an abundant and reliable source of water throughout much of the state in order to meet the emergency.

2. Current Supply and Demand

IC 14-25-7-11 calls for the continued assessment of the state's surface and ground-water resources. IC 14-25-7-15 requires that all "significant water withdrawal facilities" register with the Natural Resources Commission (NRC), and report annual water withdrawals. By the end of 1990 there were 3,119 active registrations on file with the department, including 4,710 wells and 1,398 surface intakes.

During 1990, total water use was reported to be approximately 9.3 billion gallons per day (BGD). Ground-water withdrawals accounted for 0.5 BGD. Even during dry years such as 1988, only 5.9% of the total reported water use in the state was from ground-water sources.

Water use information currently available to the department indicates that approximately one-third of the total registered ground-water withdrawal capacity is being utilized in any given year. Even during the drought of 1988, only about 41% of the total capacity was reportedly withdrawn. Although some facilities that rely solely upon ground water did experience water supply problems during 1988, the shortages were typically a function of inadequate distribution, or a lack of water supply capacity from existing wells, rather than the result of ground-water depletion.

3. Statewide Ground-water Availability

In general, Indiana has an abundant supply of ground water. It is estimated that nearly one hundred trillion gallons are available in storage. With the exception of portions of the southern part of the state, ground water can be relied upon to furnish an adequate supply of water for much of the population. A map showing the generalized ground-water availability in the state is attached as Appendix II. If properly developed, this available ground-water supply, plus the annual recharge from precipitation, can provide Indiana residents with a dependable source of water to help meet existing and future needs.

The long-term supply of water to Indiana, in the form of precipitation, amounts to a statewide average of 38.0

inches per year. Approximately 3.0 to 3.6 inches of this annual rainfall, or a range of 143,000 to 171,000 gallons of recharge per day per square mile, is believed to be contributed to the ground-water resource of the state. Considering that Indiana has an area of 36,532 square miles, approximately 5.2 to 6.2 billion gallons of water is added to the state's ground-water resource each day. It should be noted that the ground-water withdrawals of 0.5 BGD reported during 1990 represent only 8% to 10% of the daily "recharge" added by precipitation, and the total statewide ground-water withdrawal capability of 3.4 BGD reported during 1990 is only 55% to 65% of this daily total.

Although current reported ground-water pumpage represents only about 10% of the annual recharge expected from precipitation, there are locations in the state where existing ground-water withdrawal facilities could exceed the recharge capability of aquifer systems. For example, in areas of northwestern Indiana where extensive irrigation pumpage occurs, the short-term recharge capability of an aquifer might be exceeded during the growing season and water is removed from storage. Under IC 14-25-4-12, the Department of Natural Resources is granted the authority to restrict significant ground-water withdrawal facilities if it is reasonably believed that continued ground-water withdrawals from the facility will exceed the recharge capability of the ground-water resource of an area. To date, the department has restricted pumpage on only one occasion under this specific provision of the law where extensive agricultural irrigation was occurring in Jasper and Newton Counties during the summer of 1988. Because of the seasonal nature of irrigation pumpage, ground-water levels typically recover prior to future growing seasons, and restrictions are only temporary.

4. Potential Limitations to Development

In those parts of the state where significant development of the ground-water resource is possible, wells could be installed in order to meet emergency and long range water needs. The development of the ground-water resource for public water supply however may be hampered due to the current permitting process that allows for a significant amount of public input concerning the siting of new wells or well fields. As a result, emergency ground-water development may be effected (or be significantly delayed) for reasons other than the availability of the resource itself.

While not generally applicable to the emergency development of the ground-water resources, consideration should be given to how much water can be safely pumped from an aquifer system, or the determination of its "safe yield". The meaning of "safe yield" originally had only hydrogeologic considerations, but has evolved into a term that now involves hydrogeologic, economic, environmental and legal concerns. In order to determine the impact caused by increased development of the state's ground-water resource, and whether the pumpage would exceed the safe yield of a particular aquifer, pumping tests and analytical or numerical models should be utilized. Pumping tests and analytical models have the potential to provide general insight into the impacts caused by ground-water withdrawals.

B. Utilization of Minimum Stream Flows

IC 14-25-7-14 authorizes the Natural Resources Commission to determine and establish the minimum flow of streams. While the statute does not define minimum stream flows it suggests that in establishing such values, consideration should be given to the varying low flow characteristics of the streams of the state and the importance of instream and withdrawal uses, including established water quality standards and public water supply needs. In determining a minimum stream flow, perhaps the most critical determination is the amount of flow needed to sustain the instream uses on a given stream. Historically, in Indiana the stream flow equivalent to the 7Q10 (lowest seven (7) day average flow having a ten (10) year recurrence interval) could be considered to be the minimum stream flow. This value is a critical factor in determining the level of treatment required for discharges into the state's rivers and streams. Since this criteria is critical to protecting water quality and little attention has been directed at assessing the minimum flow needed to sustain other instream

uses in Indiana, the 7Q10 is commonly looked at as the minimum acceptable stream flow.

Numerous methods exist to evaluate the instream flow requirements for other purposes such as fisheries or recreation. While much work has been done on this issue, particularly in other states, none appears to be clearly applicable to Indiana.

In 1990, the Department entered into a contract with Purdue University to assist in the development of instream flow criteria for Indiana. Instream flow requirements in Indiana include the flow required to maintain fish habitat, recreation, water quality and hydropower generation. The Purdue study concluded that the instream flow requirements sufficient to maintain fish habitat are usually the highest of all instream flows in Indiana. For instream flow requirements for waste assimilation and water quality maintenance it was concluded that: (1) a flow corresponding to 7Q10 is satisfactory to meet water quality standards at all but four of 25 locations analyzed; (2) a low flow statistic of 61Qmed is satisfactory to meet water quality standards at all twenty five (25) stations; (3) during the summer season ammonia toxicity is more important than dissolved oxygen in determining instream low flow required to maintain water quality; and (4) during the winter season ammonia toxicity alone dictates the minimum instream low flow required to maintain water quality.

The Purdue study offered the following recommendations:

- (1) To maintain a satisfactory fish habitat it is recommended that the Indiana Department of Natural Resources evaluate and implement the following instream flow criteria: (1) net withdrawal from the stream may be permitted if the flow is higher than the highest instream flow required for fish survival. From streams with basin areas exceeding 1500 square miles, withdrawal may be permitted if flows are greater than 61Qmed (May-October) (or Q80%); (2) If flows less than 61Qmed (May-October) (or Q80%) occur, net withdrawals may be restricted but not prohibited. From streams receiving low groundwater contributions and with basin areas less than 1500 square miles, net withdrawals may not be permitted if flows are less than 61Qmed (May-October) (or Q80%); (3) No net withdrawals are acceptable if the flow is less than annual 7Q10.
- (2) To maintain water quality it is recommended that the Indiana Department of Natural Resources implement the following instream flow criteria: (1) Net withdrawal from a stream may be permitted if the flow is higher than the highest instream flow required for maintenance of water quality. Withdrawal may be permitted if flows are greater than 61Qmed (May-October); (2) If flows are less than 61Qmed (May-October), withdrawal may be restricted but not prohibited; (3) If flows are less than 7Q10, withdrawals may be permitted, but are not recommended.

The report refers to 61Qmed (May-October) which is the median flow estimated by using the lowest 61-day flows occurring over the May to October period of each year. These flows are approximately equal to the flows which are exceeded 80% of the time, referred to as Q80%. The Q80% value is easier to determine based on existing data and has therefore been substituted for 61Qmed.

Based on the Purdue Study the following conclusions can be reached:

- (1) A stream flow equivalent to Q80% seems to be the desirable minimum flow to be kept in streams to maintain the instream flow requirements in Indiana. Net withdrawal from a stream should perhaps be restricted but not prohibited when stream flows are lower than Q80%.
- (2) A stream flow equivalent to 7Q10 (lowest seven (7) day average flow having a ten (10) year recurrence interval) seems to be the absolute minimum flow to be kept in streams to maintain instream flow requirements in Indiana. Net withdrawal from the stream should be prohibited when stream flows are

lower than 7Q10 unless absolutely necessary to protect the public health, welfare or safety.

- (3) In streams receiving low ground water contributions and with drainage areas less than 1500 square miles and when water quality is an issue (presence of a significant amount of effluents in the stream reach), it may be necessary to adopt a stricter threshold value than 7Q10 as the absolute minimum stream flow.
- (4) It is important to note that the instream flow criteria purposefully refer to net withdrawals and not necessarily to total withdrawals. This means that water users may withdraw water from a stream at any time so long as they return the same amount of water to the stream in close proximity to its intake point without a significant degradation in its water quality. Such a scenario can occur only in the event the user has a supplementary source of water (such as an offstream reservoir) so that the consumptive uses can be compensated for. Therefore, before imposing restrictions, users should be encouraged and given the chance to plan and develop standby offstream water sources if they cannot tolerate restrictions or possible shutdown of their water withdrawals.

B. Use of Water in Lakes, Reservoirs and Streams

1. Lakes

There are over 500 natural lakes in the State of Indiana containing an undetermined amount of water. Most of these lakes are developed and many have been stocked with fish by the Department of Natural Resources. Many have a water level which has been established by court action and the Department is obligated to maintain that level. IC 14-26-2-6 requires that a permit must be obtained from the Department prior to changing the level or shoreline of the lake. It should be noted that these lakes are a source of raw water and only a few of these lakes currently are a part of the water supply system of any community. The Natural Resources Commission has historically allowed water withdrawals from these lakes only when their water levels were above their legally established normal level.

2. Reservoirs with State Owned Water Supply Storage

The State of Indiana owns water-supply storage in Brookville, Patoka and Monroe Reservoirs. The state has contracts to sell water to various parties from each of these reservoirs, either for direct withdrawals from the reservoir or for release for water withdrawals downstream of the reservoir. Uncontracted water supply is available at each reservoir and could be made available for allocation if the need arises. The staff of the Division of Water, DNR have estimated the uncontracted yield remaining at each of these reservoirs. This raw water could be made available to communities with supply problems. At each of these reservoirs there is at least one utility which has a treatment facility to purify raw water. It is possible that excess treated water could be provided to communities with water supply needs. As a part of this plan, contacts will be made with these utilities to ascertain the additional amounts of treated water which might be provided to communities in need. Raw water could also be released from the reservoirs to protect water quality or provide raw water to users downstream of the reservoirs.

IC 14-25-2 sets forth the criteria whereby the State may enter into a contract to sell water from these reservoirs. As now written, the process to accomplish this can take six months or longer. Therefore, for purposes of this plan, statutory changes would be needed to authorize the Department to quickly enter into short term contracts to address the water supply problems which might be associated with a drought.

It should be noted that additional utilization of the water supply storage of these reservoirs will produce lower levels thereby increasing the likelihood of having negative impacts on the other areas of interest to the Department such as, use of boat ramps, damage to fisheries, wetlands, etc.

3. Flood Control Reservoirs

As a part of this plan, contact will be made with the U.S. Army Corps of Engineers to ascertain if raw water supply could be made available from several Corps' reservoirs in the Upper Wabash River Basin. These reservoirs were built for flood control purposes but have a summer pool which is maintained. Winter pool levels are lower than summer levels and, therefore, releases could be initiated early if water supply is critical. Water in these reservoirs could be used for transport to communities or for release to meet water withdrawal or water quality needs downstream of the reservoirs.

XI. Data Needs and Plan Review

Throughout the process of developing this plan numerous comments were made regarding the inadequacy of data in selected areas. Specific concerns included the groundwater data base, new data generated by well head protection programs, inadequate number of gaging stations, the need to complete the Department's basin studies, etc. A number of these deficiencies make it difficult to be more specific regarding the actions which will be mandated during a water shortage. As years go by the data available will increase and could allow for the development of more definitive response plans to the consequences of a water shortage. Therefore it is recommended that in developing legislation which will establish a standing Water Shortage Task Force, the legislation should require that the Task Force review the contents of this plan and update or revise it as needed. The time period should be every two years at a minimum or every five years as a maximum.

APPENDIX I

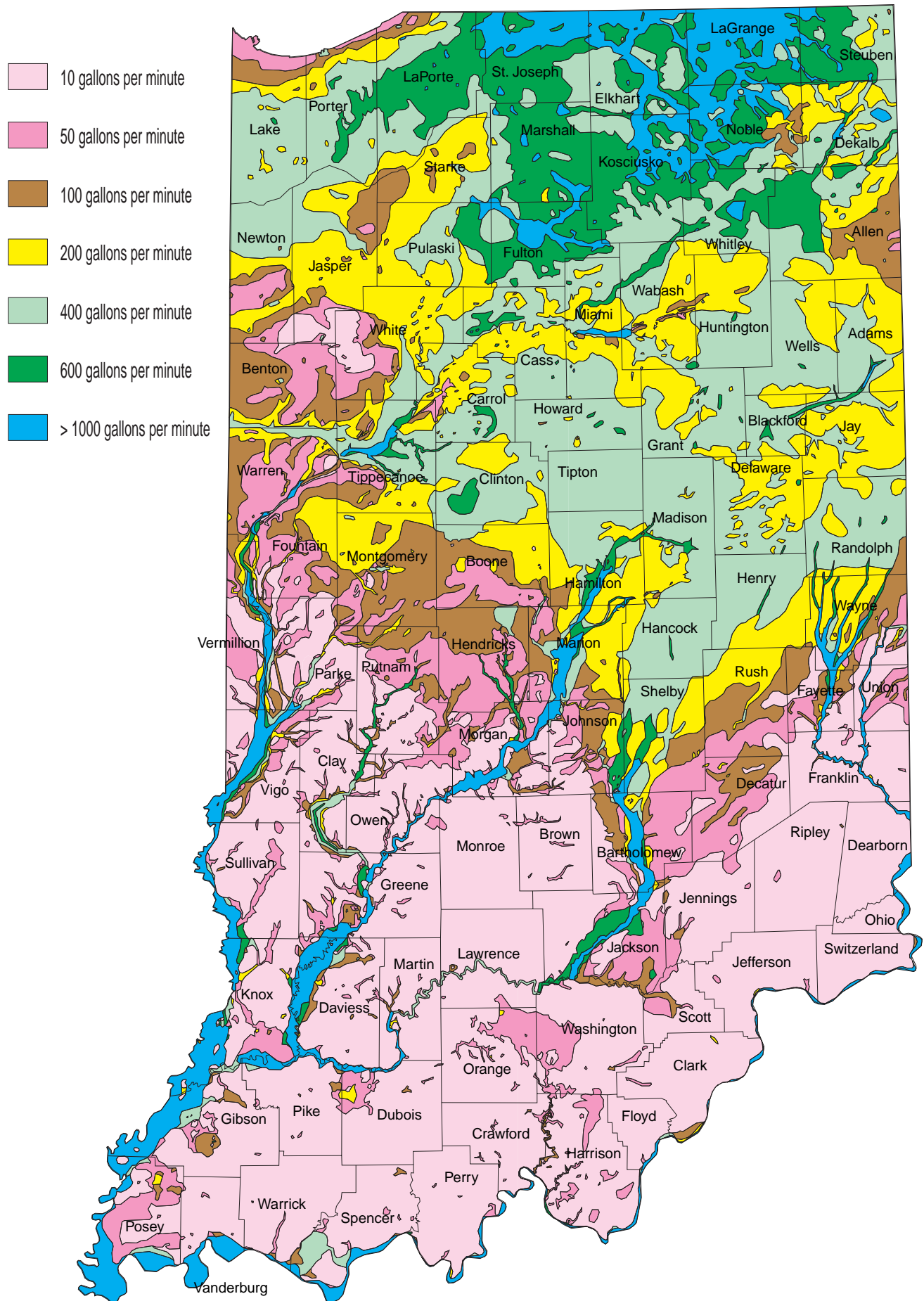
Indiana Code 13-2-6.1-10 (since repealed)

APPENDIX II

State Ground-Water

Availability Map

Generalized Ground-Water Availability



Ground-Water Availability

Ground-water capabilities vary widely in the state, ranging from as little as 10 gpm or less to over 2,000 gpm to properly constructed, large-diameter wells. The availability of ground-water on a statewide basis is shown on the reverse side. This generalized ground-water potential map portrays the range of probable maximum yields which can be expected from a properly constructed large-diameter well penetrating the full thickness of the aquifer. The ground-water yield potential represents a consolidation of both unconsolidated and bedrock aquifers with similar water yielding characteristics.

Potential Yield Categories

There are seven ground-water yield categories in Indiana as shown on the Generalized Ground-Water Availability Map. Category 1 shows the poorest water yielding areas with well yields usually less than 10 gpm. Dry holes are common in many of these areas. Category 1a depicts areas of marginal ground-water supplies with well yields generally less than 10 gpm; however yields of 50 gpm occur in localized areas. Some dry holes may also occur in these areas.

Category 2 represents areas of limited groundwater availability but slightly better than categories 1 and 1a. Wells are expected to produce between 5 to 100 gpm, although yields may be less in some areas. Category 3 includes areas with fairly good ground-water conditions, with yields from 100 to 200 gpm. Category 4 indicates those areas with wells capable of producing yields from 200 to 400 gpm. Category 4a identifies areas with very good ground-water conditions with well yields usually between 400 to 600 gpm. Category 5 delineates those areas where wells may potentially yield 1,000 or more gpm.

The various categories of ground-water yields are only a measure of the relative productivity of the several aquifer systems. These yield potentials do not indicate that an unlimited number of wells of the specified yield can be developed in any given location. Detailed studies including exploratory drilling and test pumping should be conducted to adequately evaluate the groundwater resource in any given area and the resultant change in water level as produced by the pumpage.

Regional Ground Water Conditions

Northern Indiana In general, the ground-water resource of northern Indiana can be classified as being good to excellent, and exclusive of some areas in northwestern

Indiana, well yields of from 200 to 2,000 gpm or 0.3 to 2.8 million-gallons-per-day (mgd) can be expected in most areas. Major areas of ground-water availability are found where the productive Silurian-Devonian bedrock aquifer system underlies large areas and where deposits of glacial material up to 500 feet in thickness contain highly productive inter-till sand and gravel aquifers. A number of major outwash plain and "valley train" sand and gravel deposits are associated with the St. Joseph, Elkhart, Pigeon, Fawn, Eel, and Tippecanoe River valleys. These sources are capable of large ground-water production. Wells with capacities greater than 400 gpm, or 0.6 mgd, are quite common.

Central Indiana In the central portion of the state ground-water conditions range from fair to good. Well yields from 100 to 600 gpm or from 0.15 to 0.9 mgd are typical for many large-diameter wells. Both outwash sand and gravel and limestone and dolomite bedrock aquifers are tapped to meet the needs of the users of large volumes of water. Major ground-water sources are present in the valleys of the West Fork of the White, Whitewater, Eel, and Wabash Rivers, and in portions of the valleys of Eagle, Fall, and Brandywine Creeks and the Blue River. Bedrock aquifers in the Silurian-Devonian limestone sequence are also frequently utilized, and wells in these deposits are capable of yielding from 100 to 600 gpm or 0.15 to 0.9 mgd. Locally, thicker inter-till sand and gravel aquifers are present that are capable of meeting small municipal and industrial needs. These sources are normally capable of yielding up to 300 gpm.

Southern Indiana Many areas of the southern part of the state are particularly lacking in ground water, and only limited amounts, generally less than 10 gpm, are available to properly constructed wells. In these areas the major sources of ground water are present in the sand and gravel deposits of the stream valley aquifers. These sand and gravel aquifers are extensively tapped by a number of municipalities, rural water systems and irrigation users. The valleys of the Eel, Ohio, Wabash and Whitewater Rivers as well as the East Fork, West Fork and main stem of the White River are underlain by thick deposits of outwash sand and gravel capable of supplying over 1,000 gpm or 1.4 mgd to properly constructed, large diameter wells.

APPENDIX III

Indiana Suggested Ordinance

INDIANA SUGGESTED ORDINANCE

An ordinance for the conservation and rationing of water furnished by the *City of _____

BE IT ORDAINED by the *City of _____, Indiana

WHEREAS, from time to time climatic and other conditions, both natural and man-made, may arise or occur which cause
a temporary shortage of water; and

WHEREAS, such conditions may affect the _____ public water system's ability to provide an adequate supply of water or where the public water supply may be unable to maintain adequate water pressure in the delivery system; and

WHEREAS, in such an event it is imperative to the well-being of the citizens of the *City of _____ that the use of water not essential to the health, welfare and safety of the *City of _____ and its citizens be restricted,

NOW, THEREFORE, BE IT ORDAINED by the *City of _____

*(Rural Water Districts may substitute Rural Water District _____ of _____ County, Towns may substitute Town of _____, Conservancy Districts and Regional Water Districts may substitute Conservancy District or Regional Water District. County Commissioners may act on behalf of Rural Water Corporations and Municipalities may act on behalf of private water companies.)

Section 1. *Application.* This ordinance shall apply to all persons, firms, partnerships, corporations, company or organizations of any kind connected to the _____ public water system or using water therefrom (hereafter, users).

Section 2. *Declaration of Need.* Upon determining that the *City of _____ public water system is in imminent danger of a shortage of water or is experiencing a shortage of water, the governing body shall declare a water conservation emergency and establish the appropriate conservation measures and the duration thereof.

Section 3. *Voluntary Conservation.* In accordance with Section 7, users shall be requested to reduce water consumption by practicing voluntary conservation techniques. The governing body shall suggest reasonable and meaningful actions which will alleviate existing or potential water shortage

Section 4. *Mandatory Conservation.* In accordance with Section 7, users shall be prohibited from the water uses listed below, subject to reasonable terms, times and conditions as the governing body shall determine.

- a. Sprinkling, watering or irrigating of shrubbery, trees, grass, ground covers, plants, vines, gardens, vegetables, or any other vegetation.
- b. Washing of automobiles, trucks, trailers, mobile homes, railroad cars or any other type of mobile equipment.
- c. Cleaning or spraying of sidewalk, driveways, paved areas, or other outdoor surfaces.
- d. Washing and cleaning of any business equipment or machinery
- e. The filling of swimming pools, wading pools and ornamental fountains.
- f. Knowingly allowing leakage through defective plumbing.

Section 5. *Rationing.* In addition to the mandatory conservation measures identified in Section 4 and in accordance with Section 7, users shall be limited to water use per the following schedule:

- a. Residential use shall be limited to _____ gallons per person per day.

- b. Business, commercial and industrial users shall be limited to _____ percent of the volume of water used during the corresponding month of the preceding year. Business, commercial Of industrial users that were not in business and operating in the area served by the _____ Public Water System more than one year prior to the declaration of need shall be restricted to _____percent of the average monthly volume of water used during the number of months such business, commercial and industrial user was in business and operating in the public water system area.

Section 6. *Exceptions.* The governing body of the *City of _____, reserves the right to establish alternative rationing requirements for the following:

- a. Health care providers.
- b. A reasonable use of water to maintain adequate health and sanitary standards.
- c. Those industrial and agricultural activities declared to be necessary for the public health and well-being.

Section 7 *Notice.* Notice of voluntary conservation measures shall be by publication in a local newspaper of general circulation or other means as deemed appropriate by the governing body. Said notice shall be effective upon publication.

Notice of mandatory conservation or rationing shall be by first class United States mail, or by other door to door distribution to each current user, and by electronic and print media. Said notice shall be deemed effective at the conclusion of door to door distribution, or at noon of the third day after depositing same in the United States mail.

Section 8. *Enforcement.* Any user who violates Section 4 or 5 of this ordinance may be punished by a fine of not more than \$2,500 *see IC 36-1-3-8 (a)(10)(B)*. Each day of violation shall constitute a separate offense. In addition to, or in the alternative to a fine, water service may be terminated for any user who violates Section 4 or 5 of this ordinance.

Section 9. *Effective Date.* This ordinance shall be in full force and effect upon passage.

Passed and adopted by the *City of _____, Indiana, on the _____ day of _____, 19.

